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The DCP-1 Dual Controller / Phaser for remotely-tuned active antennae

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The DCP-1 Dual Controller / Phaser is designed to tune two varactor-tuned remote active antennae independently and, if desired, combine the signals from each antenna so that phase cancellation of a dominant station or noise source may be effected. As in the case of two-wire phasing units such as the MWDX-4 (see my 1985 article, available as NRC / IRCA reprints), the goal of such cancellation is the reception of desired DX targets normally covered by a dominant station (or electrical noise). Because the phase between the two antennae on the signal to be nulled can be adjusted to 180 degrees (at equal amplitudes) and other signals may be present at different phase and amplitude relationships, nulling of a dominant "pest" need not cause nulling of desired (subdominant) signals. Nulling both pests and DX does sometimes occur - this will be discussed later.

DCP-1 controls and jacks are compatible with the two remotely-tuned antenna systems that I have recently documented: the RTL-1 Remotely-Tuned Loop and the RTU-1/MFJ 1024 Remotely-Tuned Active Whip. Two cables connect the DCP-1 to each active antenna (4 DCP-1 -to- antenna cables total). One of these two cables per antenna is the coaxial line which transfers DC power (+12 V nominal) to the antenna and RF output from it. The other cable transfers varactor and bandswitch-relay control voltage to the antenna.

DCP-1 Inputs / Outputs

J1: transfers DC power to, and RF from, active Antenna #1
J2: transfers DC power to, and RF from, active Antenna #2
J3: transfers varactor and relay control to active Ant. #1
J4: transfers varactor and relay control to active Ant. #2
J5: input for local ground
J6: transfers RF from the DCP-1 to the receiver
J7: input for DC power source (+12 volts)

DCP-1 Controls

R1: adjusts amplitude of signal from active Antenna #1
R2: adjusts amplitude of signal from active Antenna #2
R3: adjusts the varactor voltage that tunes Antenna #1
R4: adjusts the varactor voltage that tunes Antenna #2
R5: adjusts the output level of the DCP-1

S1: controls the relays in Antenna #1 and Antenna #2 that select low-band or high-band frequency range
S2: turns DC power to the DCP-1 unit on or off
S3: selects Antenna #1 output, Antenna #2 output, or one of the two null modes (a or b) that combine the Antenna #1 and Antenna #2 outputs
S4: turns the DCP-1's output amplifier on (for extra gain when needed) or off

FIGURE 1 DCP-1 DUAL CONTROLLER / PHASER SCHEMATIC

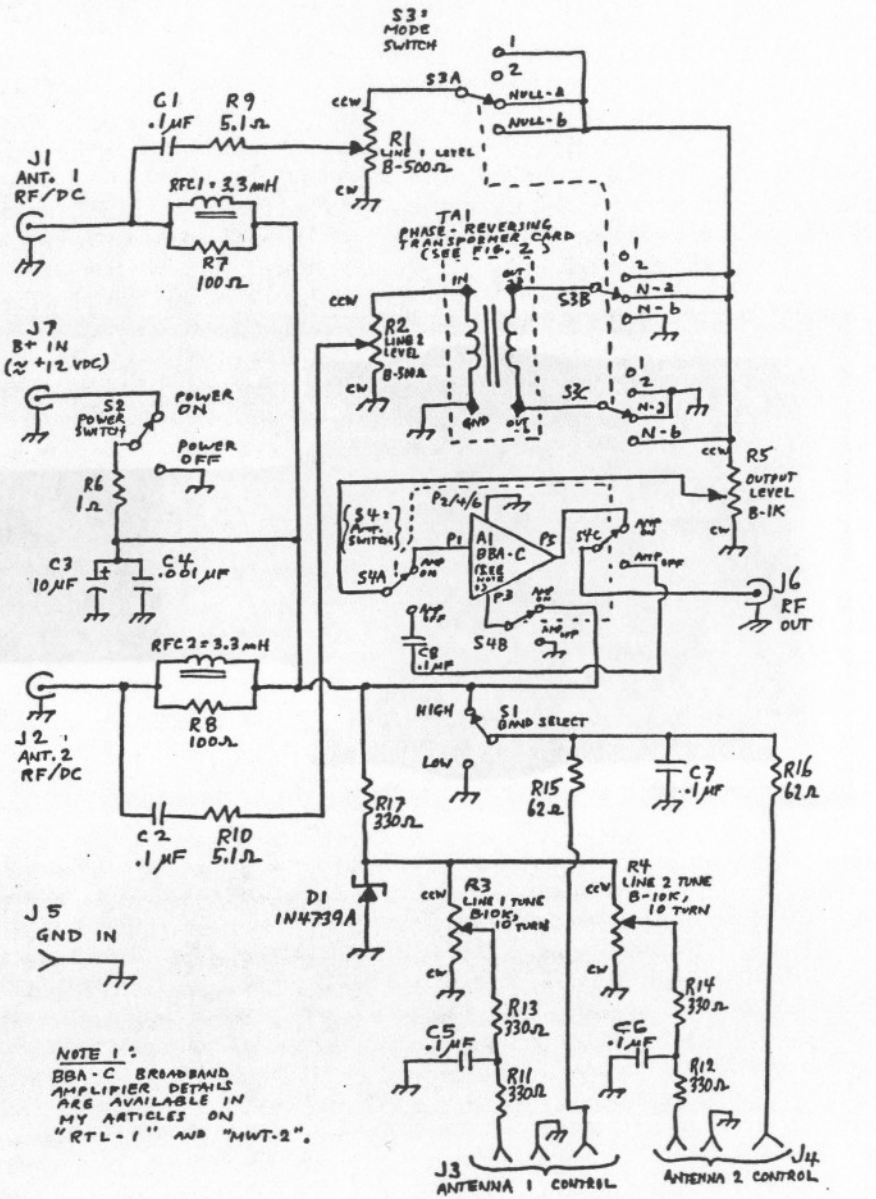

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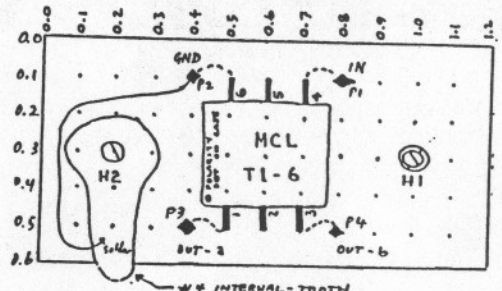
FIGURE 2 TAI PHASE-REVERSING TRANSFORMER CARD SUBASSEMBLY

(FOR PARTS LIST, SEE TABLE 3.)



♦ = "FLEA CLIP" TERMINAL PIN

Using the DCP-1

Refer to Figure 1 and to the block diagram in the appendix.

Preliminary Set-up

Connect Antenna #1 to J1 (RF/DC) and to J3 (control). Connect Antenna #2 to J2 (RF/DC) and to J4 (control). Connect local ground, if desired, to J5. Connect the receiver to J6. Connect DC power (+12V) to J7. Set R1, R2, and R5 fully counterclockwise (CCW) (maximum resistance arm to ground). Ignore, for the moment, the settings of R3, R4, S1, and S3. Set S2 to Power On (up) and set S4 to Amplifier Off (down).

Tune Antenna #1

Set S3 to "1". Adjust R3 for a peak signal on the desired frequency. If a well-defined peak does not occur, or if it is at the CCW or CW end of R3's adjustment range, change the setting of S1 (the band-select switch) and then re-adjust R3 to get the desired peak.

Tune Antenna #2

[Note: Antenna #2 must be tuning-range compatible with Antenna #1 as there is only one band-select switch (S1).] Set S3 to "2". Adjust R4 for a peak signal on the desired frequency.

Phasing with the DCP-1 (Introduction / General Discussion)

Phasing methods are not "cast in concrete"; numerous working strategies exist. When the dominant station to be nulled is approximately equal in strength with S3 on "1" (Antenna #1) and on "2" (Antenna #2), phasing is relatively straightforward. When a substantial difference in "pest" station (or noise) strength exists between the two antennae, methods of *nulling* become more varied. Suffice it to say, as a DXer gains experience using the DCP-1 for phasing, the correct strategy to set up a given null will become apparent. The goal here is to balance the dominant signal amplitude contributions from each antenna and to establish a 180-degree phase shift to cancel the dominant signal. What can make phasing a bit tricky is that any change in phase (done by detuning one of the antenna's varactors) also changes the amplitude from that antenna. Sometimes, just adjusting tuning will simultaneously set the phase and the amplitude to the correct values to establish a null. More often, the interplay of level pot settings and tuning-voltage pot settings is required to create a null.

Another issue that must be considered is collateral nulling of DX along with "pests". The likelihood of this occurring is much less if an active loop is phased against an active whip than if two whips or two loops are phased. Useful nulls - those that remove pests without killing DX as well - have been obtained using two loops when the loops have been spaced at least 6.6 ft./2m apart and oriented at right angles to each other. For two whip phasing, or for two loop phasing where the two loops are oriented similarly, my experience has been that useful nulls only occur when there is a substantial distance (at least 33 ft./10m - or better yet, upwards of 66 ft./20m) between the two antennae. Furthermore, results are best when a line drawn through the two antennae extends either to the station to be nulled or to the target area of wanted DX. If the line passing through the two antennae is close to perpendicular to the bearings to both the "pest" and the DX, useful nulls are likely to be elusive.

Active phasing of longwires may be implemented in rural areas for high-sensitivity receiving. Using the RTL-1 or RTU-1 equipped MFJ 1024 as longwire tuner-amplifiers is not advised where strong local broadcast stations are present. In the future, higher-dynamic-range remotely-tunable longwire preamplifiers will be designed for better performance in that application. Of course, remotely-tuned longwire vs. remotely-tuned whip (or loop) phasing possibilities also exist, provided that the longwire tuner can operate without objectionable spur-creating overload.

Phasing with the DCP-1 (Sample Phasing Strategy)

1. First perform the "Tune Antenna #1" and "Tune Antenna #2" procedures given previously.

2. Set R1 and R2 about "one hour" (≈ 30 degrees) clockwise from the counterclockwise stop. Then, compare the level of the station (or noise) to be nulled with S3 on "1" (Antenna #1) and on "2" (Antenna #2).

3A. If the difference is "slight" (e. g. less than 6 dB), do not bother adjusting R1 or R2 at this time.

3B. If one of the antennae is giving a much stronger signal than the other, adjust its amplitude pot (R1 for Antenna #1 or R2 for Antenna #2) to obtain nearly-equal levels with S3 on "1", then on "2". Actual use here indicates that adjusting so you have the "stronger" antenna's level about 3 dB above the level of the "weaker" antenna helps set up a null more quickly.

4. Switch S3 between "NULL-a" and "NULL-b". One of these positions usually gives more "pest" signal reduction. That is the position to use.

5. Adjust R3 (Antenna #1 tune) to deepen the null. If no such deepening occurs, set S3 to "1", re-adjust R3 for a peak, and then return S3 to the null position selected in Step 4.

6. Adjust R4 (Antenna #2 tune) to deepen the null. If no such deepening occurs, set S3 to "2", re-adjust R4 for a peak, and then return S3 to the null position selected in Step 4.

7. Adjust the level pot (R1 or R2) that had been used in Step 3B. If neither pot had been used, start with R1. Adjust for a null. Do the same with the other level pot.

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8. By this time, in most cases, a definite null should be established. Keep interactively adjusting the level pot (R1 or R2) and the tuning pot (R3 or R4) that have the most effect until an adequate null (permitting subdominant signal reception) has been established.

9. If the desired DX station (left after nulling) is too weak, switch in the DCP-1's amplifier by setting S4 to Amp. On (up). Amplifier overloading can be managed by adjusting R5.

If the null is too "narrow-banded" (not nulling both sidebands of an AM signal as well as the carrier), set the Q-spoiling switches on the two active antennae to "Low Q" instead of "Normal Q".

To gain experience in using the DCP-1 to phase two remotely-tuned antennae, practice on daytime MW broadcast signals, especially those having a subdominant that, before null attempts, is perceivable behind the dominant station. "Graveyard" channels (1230, 1240, 1340, 1400, 1450, 1490 kHz in North America) are usually prime candidates. Phasing skip signals at night is considerably more difficult, especially above 1 MHz on short-skip where multiple skip modes and rapid changes in arrival angle occur.

DCP-1 Construction Data

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Table 1: DCP-1 hole-drilling list

X = Horizontal distance, in inches, from the vertical centerline (VCL) on the side observed. Negative values of X are left of VCL, positive values of X are right of VCL.

Y = Vertical distance, in inches, from the bottom horizontal edge of the side observed.

D = Hole diameter in inches.

Hole loci are first marked on the box with a scriber and are then drilled with a .125" bit. Subsequently, as required, the holes are enlarged to the proper size by using progressively larger bits up to that corresponding to the final desired diameter.

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Box = 7" X 5" X 3"

L E F T S I D E

Hole #	Comp. Desig.	Description	X	Y	D
1	J3	Ant.1 control-stereo phonejack	-1.25	1.75	0.375
2	J1	Ant.1 RF / DC - BNC jack	-1.25	0.5	0.375
3	G1	GND H/W - internal lug	0.0	1.125	0.125
4	J5	GND In - black banana jack	0.0	0.5	0.3125
5	J4	Ant.2 control-stereo phonejack	1.25	1.75	0.375
6	J2	Ant.2 RF / DC - BNC jack	1.25	0.5	0.375

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T O P S I D E

Hole #	Comp. Desig.	Description	X	Y	D
1	R1	Line 1 Level pot. - tab	-3.0625	3.75	0.144
2	R1	Line 1 Level pot. - shaft	-2.75	3.75	0.3125
3	R2	Line 2 Level pot. - tab	-3.0625	1.25	0.144
4	R2	Line 2 Level pot. - shaft	-2.75	1.25	0.3125
5	G2	GND H/W - internal lug	-1.75	2.5	0.125

(Table 1 - cont.)

6	R3	Line 1 tune pot. - shaft	-1.0	3.75	0.375
7	R4	Line 2 tune pot. - shaft	-1.0	1.25	0.375
8	TA1	PhaseRev.TransformerCard-H/W1	-0.5	2.5	0.125
9	TA1	PhaseRev.TransformerCard-H/W2	0.3	2.5	0.125
10	S1	Band Select switch - shaft	0.5	4.0	0.25
11	S1	Band Select switch - tab	0.5	3.75	0.144
12	S2	Power switch - shaft	0.5	1.0	0.25
13	S2	Power switch - tab	0.5	0.75	0.144
14	S4	Amplifier switch - shaft	2.0	4.0	0.25
15	S4	Amplifier switch - tab	2.0	3.75	0.144
16	S3	Mode switch - shaft	2.0	2.5	0.375
17	S3	Mode switch - tab	2.5	2.5	0.144
18	R5	Output Level pot. - tab	1.6875	1.0	0.144
19	R5	Output Level pot. - shaft	2.0	1.0	0.3125

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R I G H T S I D E

Hole #	Comp. Desig.	Description	X	Y	D
1	J7	B+ In - phono jack	0.0	1.75	0.25
2	G3	GND H/W - internal lug	0.0	1.125	0.125
3	J6	RF Out - BNC jack	0.0	0.5	0.375
4	A1	Broadband Amp. Card - H/W 3	0.875	1.625	0.125
5	A1	Broadband Amp. Card - H/W 1	0.875	0.625	0.125
6	A1	Broadband Amp. Card - H/W 4	1.875	1.625	0.125
7	A1	Broadband Amp. Card - H/W 2	1.875	0.625	0.125

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Table 2: DCP-1 "upper level" parts list

Vendor codes for this and other parts lists:

MCL = Mini-Circuits / P. O. Box 350166 / Brooklyn, NY 11235-0003

MOU = Mouser Electronics / 11433 Woodside Ave. / Santee, CA 92071 /Tel. 1-800-346-6873

RS = Radio Shack / Many locations worldwide

Item	Designator	Description/Value	Vendor	Vendor Stock #	QTY
1	-	chassis box 7"X5"X3"	MOU	537-TF-782	1
2	TA1	phase-reversing transformer card	(see Table 3)		
3	A1	BBA-C broadband amplifier card	(see RTL-I article)		
4	C1,C2,C5-C8	capacitor, 0.1 uF	RS	272-109	6
5	C3	capacitor, 10uF tant.	MOU	581-10M35	1
6	C4	capacitor, 0.001 uF	RS	272-126	1
7	D1	zener diode 1N4739A	MOU	333-1N4739A	1
8	J1,J2,J6	BNC jack	RS	278-105	3
9	J3.J4	stereo headphone jack	RS	272-312	2
10	J5	black banana jack	RS	274-662	1
11	J7	phono jack	RS	274-346	1
12	R1,R2	pot.,500 ohm, linear	MOU	31CR205	2
13	R3,R4	pot., 10K 10-turn	MOU	594-53411103	2

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(Table 2 - cont.)

14	R5	pot., 1K, linear	MOU	31CR301	1
15	R6	resistor, 1 ohm	MOU	29SJ500-1.0	1
16	R7,R8	resistor, 100 ohm	RS	274-1311	2
17	R9,R10	resistor, 5.1 ohm	MOU	29SJ500-5.1	2
18	R11-R14,R17	resistor, 330 ohm	RS	271-1315	5
19	R15,R16	resistor, 62 ohm	MOU	29SJ500-62	2
20	RFC1,RFC2	inductor, 3300 uH	MOU	43LH233	2
21	S1,S2	switch,SPDT,on-on	RS	275-326	2
22	S3	switch/3pole/4pos.rotary	MOU	10WW034	1
23	S4	switch,3PDT,on-on	MOU	10TC280	1
24	for R1-R5,S3	knob	RS	274-416	6

Small hardware items (for G1, G2, G3, A1, TA1)

25	-	screw, 4-40 X .25"	MOU	572-01880	8
26	-	split lockwasher, #4	MOU	572-00649	6
27	-	solder lug, #4	MOU	534-7311	3
28	-	hex nut, 4-40	MOU	572-00486	3

Misc. items: hook-up wire, buss wire, solder,labels "AS REQUIRED"

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Table 3: TA1 phase-reversal transformer card / parts list

Vendor codes per Table 2.

Item	Designator	Description/Value	Vendor	Vendor Stock #	QTY
1	-	perfboard(0.6"X1.2")	RS	276-1396 (cut)	1
2	H1,H2	screw, 4-40 X.25"	MOU	572-01880	2
3	H1,H2	spacer, 4-40 X .5"	MOU	534-1450C	2
4	H1	split lockwasher,#4	MOU	572-00649	1
5	H2	solder lug, #4	MOU	534-7311	1
6	P1-P4	flea-clip for .042 hole	MOU	574-T42-1/100	4
7	T1	RF transformer,1:1	MCL	T1-6-X65	1

Misc. items: buss wire, solder "AS REQUIRED"

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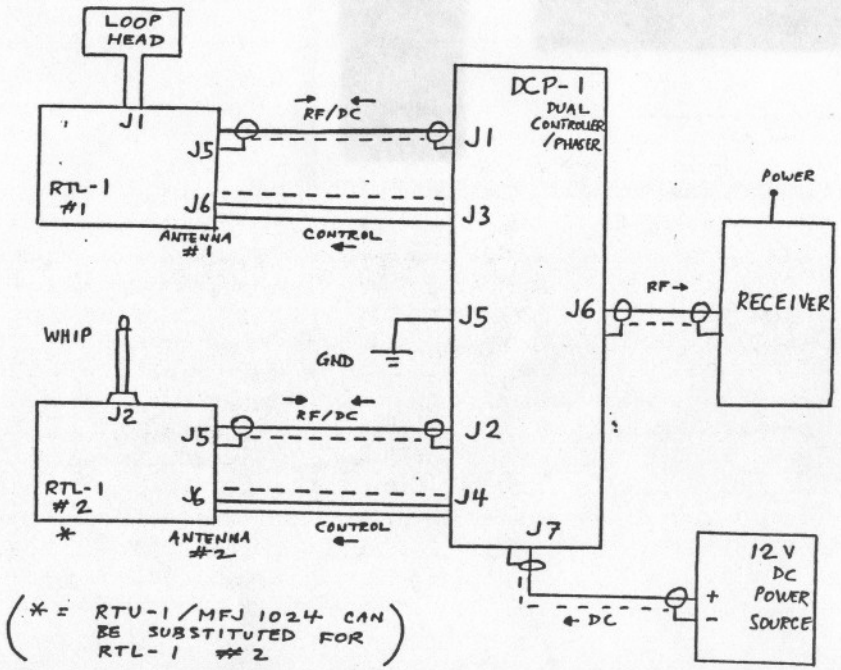
APPENDIX

BLOCK DIAGRAM OF A DCP-1 BASED LOOP-VS.-WHIP PHASING SYSTEM



(* = RTU-1/MFJ 1024 CAN BE SUBSTITUTED FOR RTL-1 #2)